Wastewater Optimization Audit

April 2010

Executive Summary

Wastewater Solutions, Inc.

Optimization Project Background

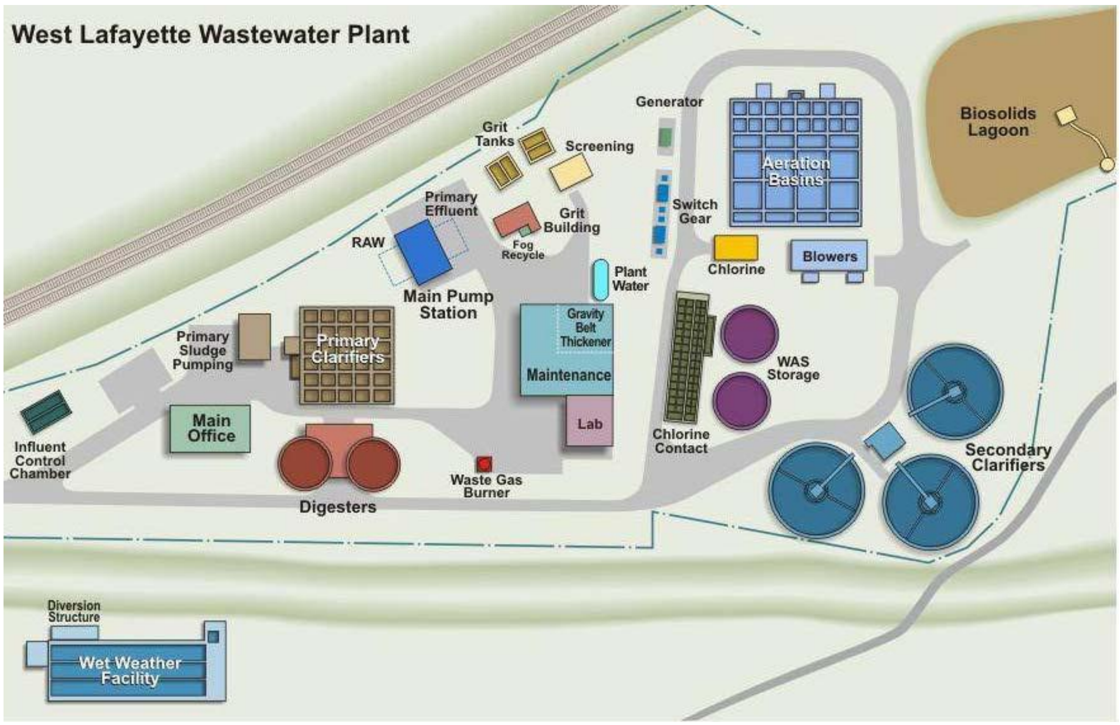
Wastewater Solutions, Inc. (WSI) was contracted to provide both onsite and offsite consulting services aimed at reducing costs and/or improving performance at the West Lafayette Wastewater Treatment Plant, West Lafayette, Indiana. The initial onsite evaluation and information collection was April 6-12, 2010. This executive briefing provides a summary of the recommendations, projected savings and process improvements resulting from this optimization effort.

Plant Overview

West Lafayette Wastewater Treatment Plant is a Class IV, 9.0 MGD activated sludge facility that treats the domestic and industrial wastewater collected within the utility's 8.67 square mile service area. The wastewater treatment plant protects the Wabash River environment by removing pollutants in the wastewater before it is discharged into the river.

The treatment plant consists of the following major processes or systems:

- Grit and Screening Removal
- Raw Pumping
- Primary Treatment
- Primary Effluent Pumping
- Aeration Basin
- Blower System
- Secondary Clarification
- Disinfection
- Wet Weather Treatment
- Solids Handling
- Anaerobic Digestion
- Facultative Lagoon



Optimization Summary

Wastewater Solutions, Inc. (WSI) took a process-by process approach to the optimization project. Potential savings and gains in system capacities were enumerated for each recommended process change. The summary of the projected savings can be seen below.

Potential Annual Savings Identified

Electrical:	$195,192
Natural Gas:	$1,591
Labor:	$3,000
Other Savings:	$274,000
	$473,783

It should be noted that the potential annual savings shown above is based on viable, practical ideas. However, West Lafayette management may decide that some ideas, while viable and legal, are not conducive to the long-term vision, goals, and direction of the utility. That stated, the staff should be able to implement the majority of recommendations contained in this technical memo. The *annual* savings the utility could realize without altering their long-term goals and mission statement is estimated to be between $250,000 and $350,000 compared to 2009 O&M costs. Some recommendations in the tables to follow do not show the potential savings they may provide. There are savings associated with the recommendations. WSI could not accurately determine the savings so they were left out of the estimates.

In addition to the annual savings discussed above, WSI also identified capacity gains to the solids handling and secondary treatment processes valued at over $900,000. These gains are based on potential increases in usable capacity brought about by changes in how the processes are operated. These capacity gains were very conservatively calculated and were not the focus of this audit.

Process Recommendations Related to Natural Gas

Equipment/Process	Change Description	Therms/Month reduction	Annual Reduction	Annual Reduction ($)
Digester	Lower temp in winter 4 degrees, This did not account for thickened WAS no data more therms when included, Did not calulate reduced heat loss thru tank walls and cover= more therms if this is included	176.6	2119.2	$1,591.46
Building Heat	Reduce temperature in the buildings. Savings not calculated		0	$0.00
	Totals	$176.60	2,119	$1,591.46

Process Recommendations Related to Electrical Energy

Equipment/Process	Change Description	Horse Power	Hours	Monthly Reduction	Annual Reduction	Monthly Reduction ($)	Annual Reduction ($)
Primary Building Temperature	Reduced temperature from 58 to 55 degrees			0	0	$0.00	$0.00
Primary Building Lights	Changed to occupancy mode. Currently 28 bulbs @60 W running continuously.		21.6	1,103	13,238	$73.36	$880.32
Primary Building Exhust Fan	Currently running 100%. Change to occupancy mode. Motor size is estimated (located on roof)	5	21	2,381	28,575	$158.35	$1,900.22
Outside Lights	Modifiy some to motion controlled			0	0	$0.00	$0.00
Primary Building Hot Water Heater	Change to Instant Hot type. Current energy is 5166 kWy approximately 30% reduction		24	129	1,550	$8.59	$103.06
PEP and RWP VFDs	Change programming for better operation - reduce surges			0	0	$0.00	$0.00
Pump Building Temp	Reduced temperature from 65 to 55 degrees			0	0	$0.00	$0.00
Pump Building Lights	Change to occupancy mode			0	0	$0.00	$0.00
Blowers	Hook up capacitor to the big blowers. This reduces engery loss and raise power factor. Based on 1 big blower operation.	12	24	6,531	78,377	$434.34	$5,212.04
Diffusers	Have diffusers checked to determine if they need cleaned. 10% improvement = 50 HP	50	24	27,214	326,569	$1,809.74	$21,716.84
Primary Blower	Shut off primary system blower during high flow periods.	20	100	1,492	17,904	$195.15	$2,341.84
Waste Tank	Shut off air to WAS tanks 6 hrs a day at peak loading to allow this air to be available for aeration basin.	30	180	4,028	48,341	$292.73	$3,512.76
Aeration	Repair ar leaks. Pipe is leaking underground. Estimated HP	10	24	5,443	65,314	$361.95	$4,343.37
Grit System	Cycle pump & collector on and off..... off 18 hrs/day	10	18	4,082	48,985	$271.46	$3,257.53
RWP & PEP	Limit peak flows to peak design flow. Run 2 instead of 3 pumps.	80	5	298	3,581	$780.61	$9,367.37
Digester Mixing	Shut down mixing during rain events	100	5	373	4,476	$975.77	$11,709.22
Grit System	Shut down redundent system(pump)	10	24	5,443	65,314	$361.95	$4,343.37
Grit System	Shut Down Redundent system (classifier & collector)	3	24	1,633	19,594	$108.58	$1,303.01
Clarifier	Shut down 1 clarifier(RAS pump)		24	6,672	80,068	$443.71	$5,324.54
Clarifier	Shut down 1 clarifier(drive)	1	24	544	6,531	$36.19	$434.34
Digester mixing	Reduce mixing energy by 25% 2-50hp pumps. Shut off for 30 min every 90 minutes.	25	24	13,607	163,284	$904.87	$10,858.42
Aeration	Shut down small blower (by cleaning septic primaries, utilizing CEPT, shutting down air to WAS tank during peak, etc.)	250	24	136,070	1,632,845	$9,048.68	$108,584.18
		Monthly Totals		217,045	kWh	$16,266.04	
		Annual Totals			2,604,546	kWh	$195,192.42

Notes regarding electrical use:

Aeration blowers are the number one energy user in activated sludge facilities.

- It is important that process changes be made to reduce the number of aeration blowers from two to one. This change alone would reduce the utility's electric bill by more than $100,000 per year. It was thought that cleaning the septic primary solids would improve BOD capture in the tanks- thus reducing the load to aeration and allowing a blower to be taken offline. However, at the time of development of this tech memo, the utility had not seen the expected improvement in BOD capture. Additional data is being collected.

- WSI requested additional testing of primary treatment process to determine if short-circuiting might be hindering BOD capture.

- Polymer trials on primary treatment performed by the West Lafayette staff showed a 28% improvement in BOD capture. Addition of polymer may be the key to reducing the load to the aeration and taking the second blower offline. It is recommended that one or two basins be set up to run with polymer addition to allow field verification of the effectiveness of polymer addition.

- Based on diurnal trends of the aeration basin dissolved oxygen (DO), it appears as though staff could take the second blower offline from approximately 12 midnight to approximately 6 am without suffering any low DO effects. Doing this while further investigating poor primary BOD removal could save approximately $40,000 per year in electricity.

- On average approximately 25%-50% of the plant's electric bill comes from the Demand Charge the electrical utility adds onto the bill based on the peak 15 minutes of electrical use during the month. The Demand Charge (also known as "peak charge") is billed at $13.08 a kW instead of the base rate of $6.65 per kW. Reducing the peak could result in thousands of dollars per year in electrical bill savings. At the West Lafayette WWTU, the peak electrical use for the month usually occurs during high flow situations. Because the plant has to "double pump" its wastewater electrical use during high flows is significant. Reducing the RWP and PEP pumps from 3 to 2 during high flows could significantly reduce costs. Taking unnecessary electrical equipment offline during high flows could dramatically reduce the demand charge.

- One place where savings is often found is in the Return Activated Sludge (RAS) rate. Incorrect RAS rates waste often result in a multitude of energy waste throughout the secondary and solids handling processes. West Lafayette was operating their RAS system perfectly. They are one of the few plants audited that were operating the RAS system properly.

RAS pump control is critical to proper biological operation and to minimize energy consumption.

Other Savings Recommendations

Recommended Change	Performance Improvement	Other Savings (specify/month)	Labor Savings (month)	Estimated Savings (year)	Capacity Gains (value)
Install fine screens at the Headworks	Reduced maintenance		$0.00	$0.00	
RWP and PEP	Improve maintenance related to rust to lengthen life		$0.00	$0.00	
Sludge Yield	Reduce sludge yield from 0.85 to 0.65 by increasing MLSS. 23.5% decrease in WAS. This would lower WAS loading, GBT run time and O&M, polymer use, TWAS pumping, increase digester and lagoon capacities, and reduce biosolids hauled from lagoon.	$5,500.00	$250.00	$69,000.00	$200,000.00
Riverroad pump station peak storage	Shave some loading during peak energy period.		$0.00	$0.00	
CEPT	Increase gas production, reduce load to AB, increase peak flow thru plant. Abasin capacity increase of 15%=$300,000. Annual gas value= $410		$0.00	$13,000.00	$300,000.00
Increase primary pumping, short term then when thick reduce pumping	Lower PE BOD to AB, Thicker Psludge -lesss dig loading, Increased digester capacity, better digestion, Increase gas, reduce load to AB-Reduce air required shut down blower-see Electrical for $108,000 in savings. Abasin capacity of 15%=$300,000. Annual gas value= $200		$0.00		$300,000.00
Increase supe off lagoon/thicken transport sludge 2009 average 1.37% thicken to 4 or 5%	Reduced truck hauling fees, Increased lagoon detention time Thicken to 4.1% reduce hauling cost 66% approximately $192K @$0.0414/gal	$16,000.00		$192,000.00	$100,000.00
	Monthly Totals	$21,500.00	$250.00		
	Estimated total annual non electrical savings:			$274,000.00	
	Capacity Gains Total				$900,000.00

Notes regarding "other" recommendations:

- Sludge yield refers to the pounds of secondary biosolids generated per pound of BOD loaded to the aeration system. Manipulating the environment in the aeration basin can result in bacteria consuming more of the biosolids (converting them into carbon dioxide, water, and more bacteria). Increasing the MLSS could result in lower secondary sludge yield. Reducing secondary sludge results in savings throughout the solids handling, digestion, lagoon and hauling processes. The plant's sludge yield is currently 0.85. The plant should easily be able to reduce the yield to 0.65-0.75. This represents a reduction in secondary biosolids of almost 30%.
- Chemically Enhanced Primary Treatment (CEPT) is the addition of polymer and sometimes ferric or alum to the primary clarifiers to increase solids and BOD capture (discussed earlier in tech memo). As discussed CEPT could assist in reducing the number and size of the blowers in operation. It can also increase the viable capacity of the aeration basins.

Plant Optimization Team Members

The savings and performance gains could not have been achieved without the leadership and commitment of plant management and staff. Staff actively involved included:

- Dave Henderson, Utility Director
- Bob Busch, Operations Manager
- John Poore, Maintenance Manager
- Jim Bjork, Instrumentation

Plant operators, maintenance personnel, and administration staff will help implement process changes and collect needed information.

The entire utility staff shares in the success of this audit. They are committed to continue investigating cost reduction measures.

Consultant Note:

It should be noted that even before this optimization project, the West Lafayette Treatment Facility was a model of performance. It is a rare management team that has the vision and willingness to investigate and instigate changes when everything is running well and costs are within utility norms. This proactive approach will pay dividends to the rate payers for years to come.

Appendix A - Baseline Data

Baseline Data

Location ID	West Lafayette
Data Start Date	1/1/2009
Data End Date	12/31/2009

Electrical Data

Average kWh cost	0.0665
Annual Consumption (kWh)	4,421,659
Peak Demand Charge	$13.08
Annual Electrical Cost	$294,040
kWh/MG	1374.9

Natural Gas

Average Therm cost	$0.75
Annual Consumption (Therm)	37887
Annual Natural Gas Cost	$28,452.00

Operating Data

Annual Flow (MG)	3,216
Final Effluent TSS (mg/l)	
Final Effluent BOD (mg/l)	
Final Effluent Ammonia (mg/l)	

Labor

Average Man hour ($/hr)	$25.00